# Description of bacterial respiratory infections among Department of Defense beneficiaries, utilizing electronic clinical laboratory data, October 2008-September 2013

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Respiratory illness is a constant threat for military personnel due to crowded and stressful occupational conditions.1 Respiratory infections are among the leading causes of ambulatory visits and hospitalizations for active duty service members. It is also one of the leading causes of ambulatory clinic visits and absenteeism from work and school in the United States (US).2,3 This study used electronic clinical laboratory data to describe bacterial respiratory infections from October 2008 to September 2013, among all Department of Defense (DOD) beneficiaries seeking care within the Military Health System (MHS). Data were analyzed by fiscal year (FY), October 01 through September 30. Upper respiratory infections (URIs) displayed seasonal trends, occurring more frequently in fall and winter months. URIs occurred more frequently in the first two years of the study period (FY 2009 and FY 2010) than in the last three years of the study period. Lower respiratory infections (LRIs) declined since 2008 and lacked seasonal trends. Overall, URIs and LRIs declined by 36% and 23%, respectively, from FY 2009 to FY 2013. Additionally, there were significant changes in the demographic and clinical characteristics of URIs and LRIs. Beneficiaries 5-17 years of age were consistently most impacted by URIs, whereas those 45 years of age and older had the highest rates of LRIs. Periodic monitoring contributes to risk reduction by tracking trends and identifying populations that exceed baseline.

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## Abstract

Respiratory illness is a constant threat for military personnel due to crowded and stressful occupational conditions.[1] Respiratory infections are among the leading causes of ambulatory visits and hospitalizations for active duty service members. It is also one of the leading causes of ambulatory clinic visits and absenteeism from work and school in the United States (US).[2,3] This study used electronic clinical laboratory data to describe bacterial respiratory infections from October 2008 to September 2013, among all Department of Defense (DOD) beneficiaries seeking care within the Military Health System (MHS). Data were analyzed by fiscal year (FY), October 01 through September 30. Upper respiratory infections (URIs) displayed seasonal trends, occurring more frequently in fall and winter months. URIs occurred more frequently in the first two years of the study period (FY 2009 and FY 2010) than in the last three years of the study period. Lower respiratory infections (LRIs) declined since 2008 and lacked seasonal trends. Overall, URIs and LRIs declined by 36% and 23%, respectively, from FY 2009 to FY 2013. Additionally, there were significant changes in the demographic and clinical characteristics of URIs and LRIs. Beneficiaries 5-17 years of age were consistently most impacted by URIs, whereas those 45 years of age and older had the highest rates of LRIs. Periodic monitoring contributes to risk reduction by tracking trends and identifying populations that exceed baseline, which may help to mitigate increased risk of morbidity and mortality, given the occupational realities of DOD personnel.

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## Executive Summary

The EpiData Center Department (EDC) at the Navy and Marine Corps Public Health Center (NMCPHC) conducts routine surveillance of clinically significant outcomes within the Department of the Navy (DON), as well as the Department of Defense (DOD). This report provides a summary of bacterial upper (URI) and lower respiratory infections (LRI) from October 2008 through September 2013. It also describes the demographic and clinical characteristics observed among DOD beneficiaries.

This study reviewed Health Level 7 (HL7) formatted microbiology and chemistry data to identify URIs and LRIs. Seasonal trend comparisons were made by fiscal year and defined as October 01 through September 30. Calculated rates provided comparison between and across the years.

The overall frequency and rate of URIs and LRIs declined from FY 2009 to FY 2013. A decrease in the rate of identification of *Streptococcus spp*. predominately accounted for the decline in URIs. Family members comprised the majority of the decline with significant reductions in rates over five years. Although there was a decline in the frequency of LRIs, there were few significant trends among organism identification across the study period.

This report assessed recent trends in URIs and LRIs in the United States (US) DOD beneficiary population. Periodic monitoring of both URIs and LRIs is important given the occupational realities of DOD personnel, such as frequent deployments, relocations, and travel. Periodic monitoring of bacterial respiratory infections contributes to risk reduction by tracking trends and identifying populations that exceed baseline, which may mitigate increased morbidity and mortality.

## Introduction

Acute respiratory infections are one of the leading causes of ambulatory clinic visits and absenteeism from work and school in the United States (US). Many of the organisms associated with respiratory infections display seasonal variation, and illness occurs more frequently in fall and winter months, when people spend more time indoors and are more often exposed to overcrowded environments. While the majority of these respiratory infections are viral, bacterial etiologies cause increased morbidity and mortality, particularly as viral coinfection or post-viral bacterial complication.[4-6]

Both upper (URI) and lower respiratory infections (LRI) within the US military population can negatively affect force health protection and mission readiness. Specific military populations such as recruits or those assigned to shipboard duty are at increased risk for both URI and LRI given the close quarters imposed on a daily basis. The Department of Defense (DOD) proscribes several policies and programs for respiratory infection surveillance among vulnerable and high-risk populations. These efforts include the Naval Health Research Center's (NHRC) febrile respiratory illness (FRI) program and service-level streptococcus/acute respiratory disease (ARD) policies, as employed in the basic training centers. However, these initiatives do not address any epidemiologic understanding of burden of illness across the overall DOD population. The literature is limited on the burden of URIs and LRIs in the overall DOD beneficiary population. This report seeks to utilize existing clinical laboratory data to describe specific bacterial respiratory infections among all DOD beneficiaries seeking care in the Military Health System (MHS) over the past five years.

## Methods

This analysis examined microbiology and chemistry data in the Health Level 7 (HL7) format at the Navy and Marine Corps Public Health Center (NMCPHC) to identify bacterial respiratory infections among all DOD beneficiaries with specimen collection dates from October 2008 to September 2013. These data represent certified laboratory results originating from the Composite Health Care System (CHCS) at the point of care (both inpatient and outpatient) within all MHS fixed military treatment facilities (MTFs). Data do not include records from purchased care, shipboard clinics, battalion aid stations, or in-theater facilities. This analysis limited chemistry data to records with rapid diagnostic testing for *Streptococcus spp.* based upon recommended diagnostic criteria included in clinical practice guidelines.[7] Microbiology was not limited by testing method and analysis included records with an identified organism. Analysis excluded records indicating nares and nasal cavity specimens as they are generally indicative of colonization rather than infection. Records with nonspecific specimen sources (i.e., swab) were also excluded. URIs were defined as specimens isolated from above the larynx (e.g., pharynx, ear, sinus). LRIs included tracheal, sputum, or bronchial specimens.

This report limited organisms to the eight most clinically significant and prevalent genera. For clinical significance, *Streptococcus*, *Staphylococcus*, *Haemophilus*, *Klebsiella*, and *Moraxella spp.* were included. For prevalence, *Pseudomonas*, *Enterobacter*, and *Escherichia spp.* were also

included. This analysis retained all *Streptococcus spp.* records, including records that lacked identification of a specific organism (e.g., beta-hemolytic streptococci, not Group A). These records were labeled as 'Strep Other' and included because other groups of *Streptococcus*, including Groups C and G beta-hemolytic streptococci, have been implicated in acute pharyngitis. In the laboratory data, *Streptococcus* groups other than A or B are not often differentiated within lab data records because there is not strong evidence in the literature that antibiotic treatment for Groups C or G prevents complications due to infection.[8] However, due to their presumed contribution to clinical infection, these *Streptococcus* groups remained in the study. This report refers to most organisms at the genus level but some genera at the species level. In the case of *Streptococcus spp.*, organisms may be referred to more specifically in this report as *Streptococcus* Group A (GAS), or *S. pneumonia*.

Unique organisms were counted once within a 14-day period. If an individual had multiple unique organisms identified within a 14-day period, each unique organism counted as a contributor to the burden of infection only once. This approach applied for unique organisms whether isolated from single or multiple specimens. Although clinical guidelines do not recommend antibiotics for most URIs, the 14-day timeframe was considered adequate given treatment duration generally prescribed for the limited cases in which antibiotics are considered effective.[9-12] This analysis also describes polymicrobial infections, or multiple organisms identified within the same specimen. These infections may have increased ability to produce biofilms, the complex matrix structures that often make infections more difficult to treat.[13,14] Antibiotics that attack certain attributes of bacteria may become ineffective due to conditions within the biofilm.[13] Research associates biofilms with common respiratory diseases such as otitis media and cystic fibrosis.[14]

This report also presents patient demographic and clinical characteristics for both URIs and LRIs. To describe patient demographics, the first record per individual per calendar year was selected to avoid overestimation due to comorbidities unable to be accounted for in this study, such as could be common with cystic fibrosis. Clinical characteristics were described by case. This analysis used the 14-day gap in care rule to determine cases. All unique organisms within a rolling 14-day period contributed to the case total, although the first record per case was used to describe patient type and classify specimens. Variables contained in the laboratory record denoted demographic and clinical characteristics such as age, gender, duty status (active duty/recruit, retired, family member, or other), and patient type (inpatient or outpatient). The TRICARE region (Alaska, North, South, West, outside the continental United States (OCONUS), and unspecified) was defined as the region of the servicing MTF and identified by the requesting facility's unique identification number. Demographics of polymicrobial infections were presented by occurrence; therefore, for every record of a polymicrobial infection, one occurrence was counted.

Frequency calculations by fiscal year, defined as October 01 through September 30, allowed for seasonal trending comparisons that aligned with the annual influenza season. Calculated rates facilitated comparisons between years. For total tests performed for both URIs and LRIs, all chemistry and microbiology tests indicating a respiratory specimen served as the denominator for

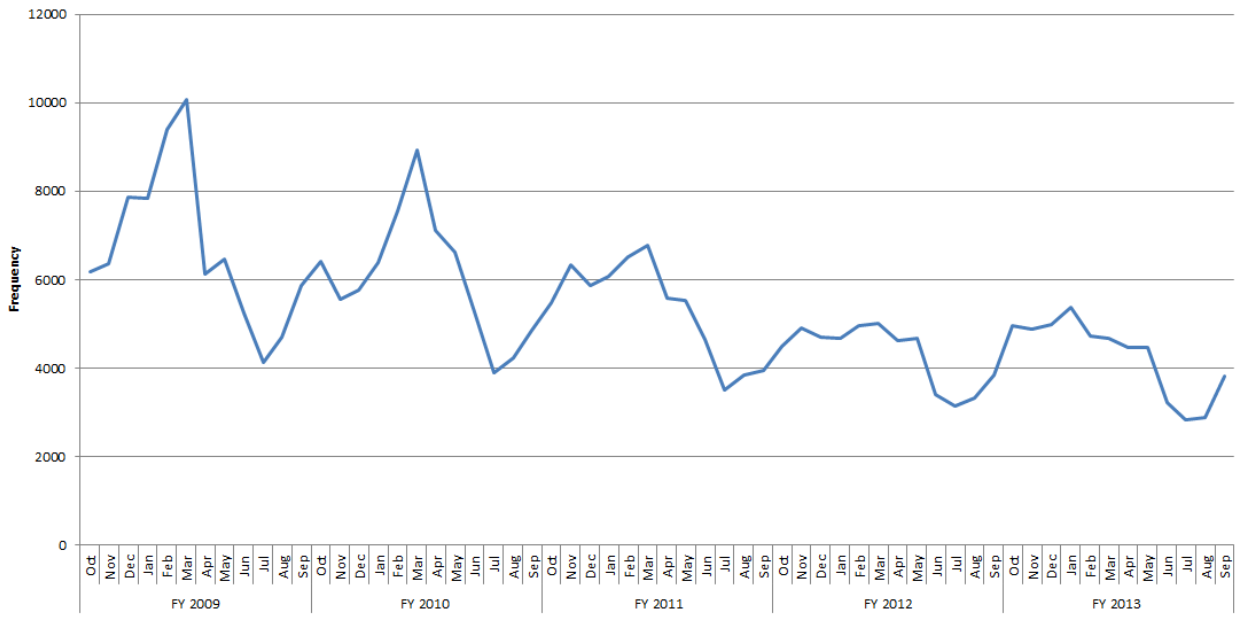
each year. Annual Military Health System Mart (M2) data generated denominators for each demographic category. The Cochran-Armitage trend test determined significant differences across the years and at $P$ value $\leq .05$. SAS 9.2 software (SAS Institute, Cary, North Carolina, US) facilitated electronic data analysis.

# Results

## Upper Respiratory Infections

From October 2008 to September 2013, DOD beneficiaries had an average of 64,000 bacterial URIs each year. Overall, the frequency of URIs decreased by 36% from FY 2009 (n=80,274) to FY 2012 (n=51,328) (Figure 1). The highest frequency of URIs occurred in March during the first three years of the surveillance period and the lowest frequencies occurred in July. In comparison, the FY 2012 and FY 2013 years did not follow this pattern, as activity appeared to plateau during the winter months with undefined peaks.

**Figure 1**. Frequency of Upper Respiratory Bacterial Infections among DOD Beneficiaries, FY 2009-FY 2013




Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

The three main organism groups identified as URIs were *Streptococcus, Staphylococcus,* and *Pseudomonas spp.* (Table 1). *Streptococcus spp*. accounted for approximately 95% of all URIs identified each season. GAS accounted for over 60% of *Streptococcus spp.* infections identified each year. *Streptococcus spp.* other than GAS, Group B, or *S. pneumonia* were the second most frequently identified organisms in this group and accounted for approximately 34% of *Streptococcus spp.* infections each year. *Staphylococcus spp.* infections accounted for approximately 3% of all URIs identified each year. *S. aureus* accounted for over 72% of the *Staphylococcus spp.* infections each year. *Haemophilus*, *Klebsiella*, *Moraxella*, *Staphylococcus*, and *Streptococcus spp*. each had a significant (*P* value <.01) trend from 2008-2009 to 2012-2013. Rates increased from the first year to the last for *Haemophilus*, *Klebsiella*, *Moraxella,* and *Staphylococcus spp.*; *Moraxella* and *Haemophilus spp.* displayed the highest increases (124% and 111%, respectively). *Streptococcus spp.* displayed a reverse pattern with a 5% decrease from the first to the last year.

**Table 1**. Distribution of Organisms Identified from Upper Respiratory Bacterial Infections with Rates of Infections per 10,000 Tests Performed among DOD Beneficiaries, FY 2009-FY 2013

| | FY 2009 | | | | FY 2010 | | | | FY 2011 | | | | FY 2012 | | | | FY 2013 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Respiratory Organisms | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | Percent change[a] | *P* value[b] |
| *Enterobacter* | 84 | 0.2 | 0.2 | 0.2 | 68 | 0.2 | 0.1 | 0.2 | 55 | 0.2 | 0.1 | 0.2 | 49 | 0.2 | 0.1 | 0.2 | 64 | 0.2 | 0.2 | 0.3 | 14.0 | 0.74 |
| *Escherichia* | 65 | 0.2 | 0.1 | 0.2 | 57 | 0.2 | 0.1 | 0.2 | 37 | 0.1 | 0.1 | 0.2 | 37 | 0.1 | 0.1 | 0.2 | 42 | 0.2 | 0.1 | 0.2 | -3.4 | 0.47 |
| *Haemophilus* | 226 | 0.6 | 0.5 | 0.6 | 230 | 0.7 | 0.6 | 0.7 | 198 | 0.6 | 0.5 | 0.7 | 266 | 1.0 | 0.8 | 1.1 | 319 | 1.2 | 1.0 | 1.3 | 111.1 | <.01 |
| *Klebsiella* | 76 | 0.2 | 0.1 | 0.2 | 67 | 0.2 | 0.1 | 0.2 | 44 | 0.1 | 0.1 | 0.2 | 55 | 0.2 | 0.1 | 0.3 | 88 | 0.3 | 0.3 | 0.4 | 73.2 | <.01 |
| *Moraxella* | 97 | 0.2 | 0.2 | 0.3 | 86 | 0.2 | 0.2 | 0.3 | 63 | 0.2 | 0.1 | 0.2 | 77 | 0.3 | 0.2 | 0.3 | 145 | 0.5 | 0.4 | 0.6 | 123.6 | <.01 |
| *Pseudomonas* | 611 | 1.5 | 1.4 | 1.6 | 532 | 1.5 | 1.4 | 1.7 | 446 | 1.4 | 1.3 | 1.5 | 379 | 1.4 | 1.2 | 1.5 | 395 | 1.4 | 1.3 | 1.6 | -3.3 | 0.21 |
| *Staphylococcus* | 2,318 | 5.7 | 5.4 | 5.9 | 2,164 | 6.2 | 5.9 | 6.5 | 1,774 | 5.5 | 5.2 | 5.8 | 1,765 | 6.4 | 6.1 | 6.7 | 1,713 | 6.3 | 6.0 | 6.6 | 10.5 | <.01 |
| *Streptococcus* | 76,786 | 187.7 | 186.4 | 189.1 | 69,330 | 198.6 | 197.1 | 200.0 | 61,469 | 190.6 | 189.1 | 192.1 | 49,070 | 177.2 | 175.7 | 178.8 | 48,551 | 177.5 | 176.0 | 179.1 | -5.4 | <.01 |
| **Total** | 80,263 | -- | -- | -- | 72,534 | -- | -- | -- | 64,086 | -- | -- | -- | 51,698 | -- | -- | -- | 51,317 | -- | -- | -- | -- | -- |

95% Confidence Intervals

[a] Rate percent change was calculated between FY 2009 and FY 2013

[b] P-value determined by conducting a Cochran-Armitage trend test, using all years in the surveillance period

Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

Table 2 presents the frequencies of bacterial URIs by demographic characteristic. Since 2008, individuals between 5 and 44 years of age had more events than the youngest and oldest beneficiaries, although those 5-17 years of age had the highest incidence rates. Each year, family members accounted for nearly 64% of URIs and active duty service members accounted for approximately 30% and had the highest incidence rates. The TRICARE North region identified the majority of URIs (30%), although OCONUS generally had the highest rates. Many of the demographic categories displayed significant trends. Those 0-4 years of age had the largest percent change in incidence, decreasing by 39% from FY 2009 to FY 2013. All of the duty status categories had significant trends (*P* value <.01). Family member beneficiaries had the largest percent decrease in incidence, 38%, from FY 2009 to FY 2013. Family member incidence rates decreased for the first four years and stabilized in the fifth year. Active duty beneficiaries incidence rates also decreased the first four years and overall had a 31% decrease, although from FY 2012 to FY 2013 the incidence rate increased by 6%. Retirees' events decreased the least, only 22%, although the trend was significant (*P* value <.01). All TRICARE regions demonstrated significant trends in incidence rates (*P* value <.01). Alaska had the largest percent change in incidence, decreasing 52% from FY 2009 to FY 2013, followed by the North (45%), and the West (39%) regions. The decreases in Alaska from FY 2010 to FY 2011 and from FY 2012 to FY2013 combine to account for a 50% difference and the large overall percent change for the region. The largest decreases in incidence for the North occurred from FY 2009 to FY 2010 (17%) and from FY 2011 to FY 2012 (24%), whereas the largest decrease for the West was from FY2011 to FY2012 (26%).

**Table 2**. Total Upper Bacterial Respiratory Infections by Demographic Category with Rates per 1,000 DOD Beneficiaries, FY 2009-FY 2013[a]

| | FY 2009 | | | | FY 2010 | | | | FY 2011 | | | | FY 2012 | | | | FY 2013 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | Percent change[d] | *P* value[e] |
| 0-4 | 6,205 | 104.3 | 101.7 | 106.9 | 5,675 | 90.0 | 87.7 | 92.4 | 5,597 | 87.9 | 85.6 | 90.2 | 4,336 | 68.9 | 66.9 | 71.0 | 3,922 | 64.0 | 62.0 | 66.0 | -38.6 | <.01 |
| 5-17 | 26,501 | 184.0 | 181.8 | 186.2 | 23,960 | 163.9 | 161.8 | 166.0 | 21,774 | 150.2 | 148.2 | 152.2 | 16,755 | 116.8 | 115.0 | 118.5 | 16,436 | 116.1 | 114.3 | 117.9 | -36.9 | <.01 |
| 18-24 | 17,998 | 137.5 | 135.5 | 139.5 | 15,635 | 118.6 | 116.7 | 120.4 | 12,908 | 99.8 | 98.1 | 101.5 | 10,967 | 87.1 | 85.5 | 88.7 | 11,484 | 93.5 | 91.8 | 95.3 | -32.0 | <.01 |
| 25-44 | 20,097 | 99.2 | 97.8 | 100.5 | 18,765 | 89.9 | 88.6 | 91.2 | 16,696 | 79.3 | 78.1 | 80.5 | 14,178 | 67.4 | 66.3 | 68.5 | 13,926 | 67.0 | 65.9 | 68.2 | -32.4 | <.01 |
| 45-64 | 2,679 | 12.1 | 11.7 | 12.6 | 2,491 | 11.1 | 10.7 | 11.6 | 2,260 | 10.0 | 9.6 | 10.5 | 1,825 | 8.2 | 7.9 | 8.6 | 1,987 | 9.2 | 8.8 | 9.6 | -24.2 | 0.09 |
| >64 | 180 | 0.9 | 0.8 | 1.1 | 166 | 0.9 | 0.7 | 1.0 | 180 | 0.9 | 0.8 | 1.0 | 173 | 0.9 | 0.7 | 1.0 | 175 | 0.8 | 0.7 | 1.0 | -11.5 | 0.29 |
| Missing | 0 | -- | -- | -- | 1 | -- | -- | -- | 0 | -- | -- | -- | 0 | -- | -- | -- | 1 | -- | -- | -- | -- | -- |
| **Gender**[b] | | | | | | | | | | | | | | | | | | | | | | |
| Female | 36,093 | 78.4 | 77.6 | 79.2 | 33,062 | 70.3 | 69.6 | 71.1 | 29,523 | 62.5 | 61.7 | 63.2 | 24,114 | 51.0 | 50.4 | 51.6 | 23,296 | 49.5 | 48.9 | 50.2 | -36.8 | <.01 |
| Male | 37,567 | 77.0 | 76.2 | 77.7 | 33,631 | 67.6 | 66.9 | 68.3 | 29,892 | 60.1 | 59.4 | 60.8 | 24,119 | 48.8 | 48.2 | 49.4 | 24,635 | 50.4 | 49.8 | 51.0 | -34.5 | <.01 |
| **Duty Status** | | | | | | | | | | | | | | | | | | | | | | |
| Active Duty | 23,163 | 156.1 | 154.1 | 158.1 | 20,883 | 139.6 | 137.7 | 141.5 | 17,884 | 119.3 | 117.5 | 121.0 | 15,184 | 102.7 | 101.1 | 104.4 | 15,761 | 108.5 | 106.8 | 110.2 | -30.5 | <.01 |
| Retired | 992 | 4.8 | 4.5 | 5.1 | 894 | 4.3 | 4.0 | 4.6 | 859 | 4.1 | 3.8 | 4.4 | 756 | 3.6 | 3.3 | 3.8 | 799 | 3.8 | 3.5 | 4.0 | -21.7 | <.01 |
| Family Member | 46,742 | 93.1 | 92.2 | 93.9 | 42,468 | 83.6 | 82.8 | 84.4 | 38,589 | 75.5 | 74.7 | 76.2 | 30,623 | 59.8 | 59.2 | 60.5 | 29,534 | 58.0 | 57.3 | 58.7 | -37.7 | <.01 |
| Other | 2,763 | 30.2 | 29.0 | 31.3 | 2,448 | 24.0 | 23.0 | 24.9 | 2,083 | 21.0 | 20.1 | 21.9 | 1,671 | 17.4 | 16.5 | 18.2 | 1,837 | 19.9 | 19.0 | 20.8 | -34.0 | <.01 |
| **TRICARE Region** | | | | | | | | | | | | | | | | | | | | | | |
| Alaska | 1,640 | 186.3 | 177.2 | 195.3 | 1,599 | 178.9 | 170.1 | 187.7 | 1,258 | 141.2 | 133.4 | 149.0 | 1,130 | 125.6 | 118.3 | 132.9 | 803 | 89.3 | 83.1 | 95.5 | -52.1 | <.01 |
| North | 24,838 | 80.6 | 79.6 | 81.6 | 20,911 | 67.0 | 66.1 | 67.9 | 17,923 | 57.5 | 56.7 | 58.3 | 13,348 | 43.8 | 43.1 | 44.6 | 13,213 | 44.6 | 43.8 | 45.3 | -44.7 | <.01 |
| OCONUS[c] | 6,653 | 154.6 | 150.9 | 158.3 | 7,088 | 167.5 | 163.6 | 171.4 | 5,598 | 136.5 | 132.9 | 140.1 | 4,424 | 111.9 | 108.6 | 115.2 | 4,432 | 117.9 | 114.4 | 121.4 | -23.7 | <.01 |
| South | 19,909 | 66.5 | 65.5 | 67.4 | 17,890 | 58.9 | 58.0 | 59.7 | 17,182 | 56.7 | 55.8 | 57.5 | 12,959 | 42.1 | 41.3 | 42.8 | 12,907 | 41.4 | 40.7 | 42.1 | -37.7 | <.01 |
| West | 20,073 | 73.0 | 71.9 | 74.0 | 18,234 | 64.6 | 63.7 | 65.6 | 16,187 | 56.6 | 55.8 | 57.5 | 12,012 | 41.9 | 41.2 | 42.7 | 12,763 | 44.8 | 44.1 | 45.6 | -38.5 | <.01 |
| Unspecified | 547 | 39.3 | 36.0 | 42.6 | 971 | 52.7 | 49.4 | 56.0 | 1,267 | 64.5 | 61.0 | 68.1 | 4,361 | 220.5 | 214.0 | 227.0 | 3,813 | 195.8 | 189.6 | 202.0 | -- | -- |
| **Total** | 73,660 | -- | -- | -- | 66,693 | -- | -- | -- | 59,415 | -- | -- | -- | 48,234 | -- | -- | -- | 47,931 | -- | -- | -- | -- | -- |

[a] First record per individual per year
[b] 1 missing value (FY 2012)
[c] OCONUS=Outside the continental United States
[d] Rate percent change was calculated between the FY 2009 rate and the FY 2013 rate
[e] P-value determined by conducting a Cochran-Armitage trend test, using all years in the surveillance period
95% Confidence Intervals
Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

Table 3 presents select URI clinical characteristics. The throat was consistently the most frequently occurring specimen source throughout the study period (97%). The outpatient setting was the predominant location of patient encounters for URI specimen collection (99.7%). There was a 39% decrease in throat specimens and in outpatient cases from FY 2009 to FY 2013.

**Table 3**. Total Upper Bacterial Respiratory Infections by Select Clinical Characteristic among DOD Beneficiaries by Fiscal Year, FY 2009-FY 2013

| | Total | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 |
|---|---|---|---|---|---|---|
| **Specimen** | | | | | | |
| Ear | 5,839 | 1,404 | 1,400 | 1,135 | 1,026 | 874 |
| Nasopharyngeal | 1,198 | 323 | 257 | 228 | 234 | 156 |
| Oral | 800 | 192 | 121 | 142 | 183 | 162 |
| Sinus | 630 | 145 | 106 | 139 | 116 | 124 |
| Throat | 302,719 | 76,527 | 69,103 | 61,230 | 49,254 | 46,605 |
| Upper, NOS[a] | 65 | 13 | 16 | 15 | 12 | 9 |
| **Patient Type** | | | | | | |
| Inpatient | 828 | 221 | 177 | 163 | 144 | 123 |
| Outpatient | 310,423 | 78,383 | 70,826 | 62,726 | 50,681 | 47,807 |
| Total | 311,251 | 78,604 | 71,003 | 62,889 | 50,825 | 47,930 |

[a] NOS=Nonspecific
Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

There were 2,054 polymicrobial URIs among 1,906 DOD beneficiaries within the study period (Table 4). URI polymicrobial infections peaked at 510 in FY 2009. Small children (0-4 years old) and family members had the highest frequencies of polymicrobial infections. The North and West regions had the highest counts of polymicrobial infections.

**Table 4**. Total Upper Polymicrobial Respiratory Infections by Demographic Category among DOD Beneficiaries, FY 2009-FY 2013[a]

| | Total | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 |
|---|---|---|---|---|---|---|
| **Age** | | | | | | |
| 0-4 | 572 | 159 | 145 | 90 | 91 | 87 |
| 5-17 | 395 | 94 | 84 | 69 | 59 | 89 |
| 18-24 | 289 | 67 | 57 | 54 | 48 | 63 |
| 25-40 | 371 | 89 | 80 | 65 | 73 | 64 |
| 41-64 | 233 | 58 | 62 | 36 | 40 | 37 |
| >64 | 46 | 8 | 10 | 7 | 8 | 13 |
| **Gender** | | | | | | |
| Female | 792 | 186 | 187 | 123 | 152 | 144 |
| Male | 1,114 | 289 | 251 | 198 | 167 | 209 |
| **Duty Status** | | | | | | |
| Active Duty | 425 | 102 | 91 | 66 | 81 | 85 |
| Recruit | 12 | 5 | 2 | 2 | 0 | 3 |
| Retired | 114 | 32 | 28 | 17 | 18 | 19 |
| Family Member | 1,284 | 317 | 301 | 222 | 211 | 233 |
| Other | 71 | 19 | 16 | 14 | 9 | 13 |
| **TRICARE Region** | | | | | | |
| Alaska | 29 | 10 | 4 | 6 | 6 | 3 |
| North | 630 | 156 | 129 | 99 | 115 | 131 |
| OCONUS[b] | 162 | 55 | 49 | 16 | 24 | 18 |
| South | 401 | 89 | 93 | 75 | 62 | 82 |
| West | 639 | 164 | 162 | 119 | 93 | 101 |
| Unspecified | 45 | 1 | 1 | 6 | 19 | 18 |
| **Total** | 1,906 | 475 | 438 | 321 | 319 | 353 |

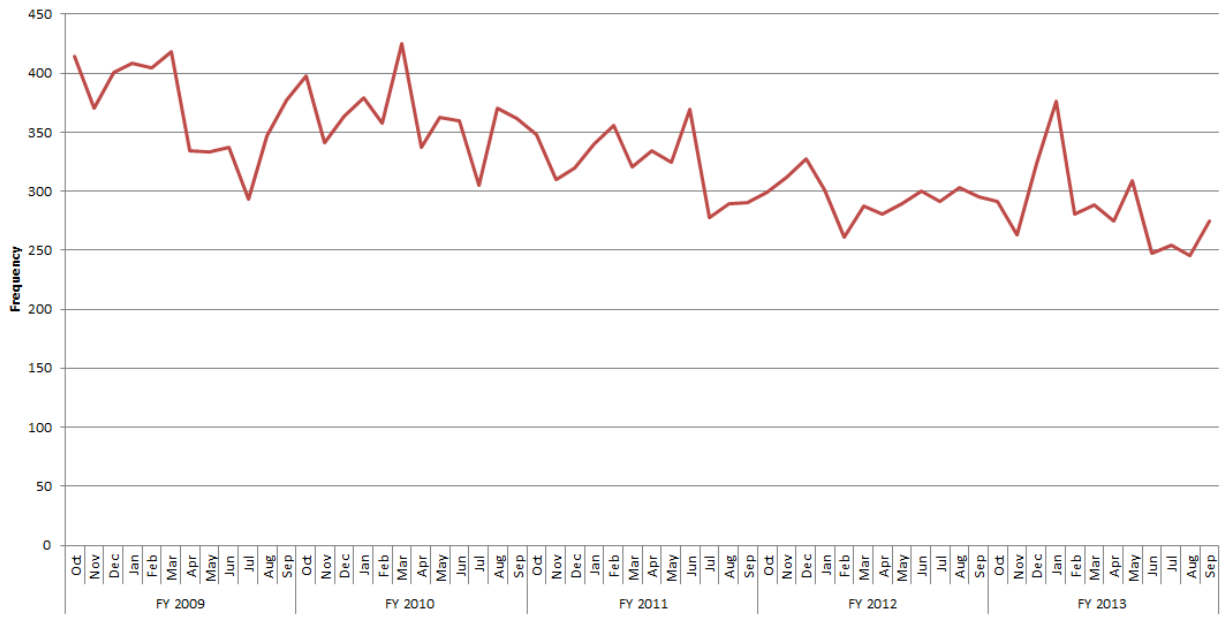
[a] First record per individual per year
[b] OCONUS=Outside the continental United States
Data Source: Navy and Marine Corps Public Health Center CHCS HL7 chemistry and microbiology data

Overall, ear (n=837) and throat specimens (n=824) yielded an approximately equal distribution of polymicrobial infections. Outpatient clinics identified the majority of infections (96%). The two most frequently identified organisms in URI polymicrobial infections were *Streptococcus* and *Staphylococcus spp.*

## Lower Respiratory Infections

From October 2008 to September 2013, DOD beneficiaries had an average of 4,000 lower bacterial respiratory infections each year. The frequency of identified LRIs decreased approximately 23% from FY 2009 (n=4,437) to FY 2013 (n=3,429) (Figure 2). No consistent trend appeared within or between years.

**Figure 2**. Frequency of Lower Respiratory Bacterial Infections among DOD Beneficiaries, FY 2009-FY 2013




Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

*Staphylococcus*, *Pseudomonas*, and *Streptococcus spp.* appeared most commonly in the lower respiratory system (Table 5). Consistently across the entire five-year period, *Staphylococcus spp.* accounted for almost one-third of all LRIs identified. Similarly, *Pseudomonas spp.* contributed approximately 21% and *Streptococcus spp.* contributed approximately 17% of the total infections each year. *S. aureus* varied minimally across the years, accounting for 87% to 90% of all *Staphylococcus spp.* infections each year. *Streptococcus spp.* other than GAS, Group B, or *S. pneumonia* accounted for over 50% of all *Streptococcus spp.* infections, ranging from 53% in FY 2009 to 59% in FY 2012. *S. pneumoniae* appeared in over a quarter of *Streptococcus spp.* infections each year. Although there were decreases in frequency, the rates of the three main organisms identified per lower respiratory tests performed did not change significantly throughout the study timeframe (Table 5). Only *Haemophilus* (*P* value .01) and *Streptococcus spp.* (*P* value <.01) had significant trends throughout the study period. *Haemophilus spp.* had a significant (*P* value <.01) increase of 20% from FY 2009 to FY 2013, whereas *Streptococcus spp.* had a 10% decrease. The rate of *Streptococcus spp.* significantly decreased (*P* value .03) from FY 2010 to FY 2011 by 11%, and significantly (*P* value .04) decreased again in FY 2011 by 12%.

**Table 5**. Distribution of Organisms Identified from Lower Respiratory Bacterial Infections with Rates of Infections per 10,000 Tests Performed among DOD Beneficiaries, FY 2009-FY 2013

| | FY 2009 | | | | FY 2010 | | | | FY 2011 | | | | FY 2012 | | | | FY 2013 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lower Respiratory Organisms | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | Percent change[a] | *P* value[b] |
| *Enterobacter* | 229 | 12.4 | 10.8 | 14.0 | 207 | 11.8 | 10.2 | 13.5 | 201 | 12.5 | 10.8 | 14.2 | 188 | 12.8 | 10.9 | 14.6 | 152 | 10.7 | 9.0 | 12.4 | -13.3 | 0.43 |
| *Escherichia* | 241 | 13.0 | 11.4 | 14.7 | 211 | 12.1 | 10.4 | 13.7 | 205 | 12.7 | 11.0 | 14.5 | 200 | 13.6 | 11.7 | 15.5 | 189 | 13.3 | 11.4 | 15.2 | 2.4 | 0.48 |
| *Haemophilus* | 453 | 24.5 | 22.2 | 26.8 | 457 | 26.1 | 23.7 | 28.5 | 405 | 25.2 | 22.7 | 27.6 | 394 | 26.8 | 24.1 | 29.4 | 417 | 29.4 | 26.6 | 32.3 | 20.2 | 0.01 |
| *Klebsiella* | 340 | 18.4 | 16.4 | 20.3 | 307 | 17.6 | 15.6 | 19.5 | 315 | 19.6 | 17.4 | 21.7 | 266 | 18.1 | 15.9 | 20.2 | 263 | 18.6 | 16.3 | 20.8 | 1.0 | 0.78 |
| *Moraxella* | 109 | 5.9 | 4.8 | 7.0 | 82 | 4.7 | 3.7 | 5.7 | 95 | 5.9 | 4.7 | 7.1 | 92 | 6.2 | 5.0 | 7.5 | 77 | 5.4 | 4.2 | 6.7 | -7.7 | 0.74 |
| *Pseudomonas* | 925 | 50.0 | 46.8 | 53.2 | 964 | 55.1 | 51.7 | 58.6 | 856 | 53.2 | 49.6 | 56.8 | 764 | 51.9 | 48.2 | 55.6 | 732 | 51.7 | 47.9 | 55.4 | 3.3 | 0.89 |
| *Staphylococcus* | 1,354 | 73.2 | 69.3 | 77.1 | 1,320 | 75.5 | 71.4 | 79.6 | 1,135 | 70.5 | 66.4 | 74.6 | 1,102 | 74.9 | 70.4 | 79.3 | 1,057 | 74.6 | 70.1 | 79.1 | 2.0 | 0.79 |
| *Streptococcus* | 786 | 42.5 | 39.5 | 45.5 | 814 | 46.6 | 43.4 | 49.8 | 668 | 41.5 | 38.4 | 44.7 | 540 | 36.7 | 33.6 | 39.8 | 542 | 38.3 | 35.1 | 41.5 | -9.9 | <.01 |
| **Total** | 4,437 | -- | -- | -- | 4,362 | -- | -- | -- | 3,880 | -- | -- | -- | 3,546 | -- | -- | -- | 3,429 | -- | -- | -- | -- | -- |

95% Confidence Intervals

a Rate percent change was calculated between FY 2009 and FY 2013

[b] P-value determined by conducting a Cochran-Armitage trend test, using all years in the surveillance period

Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

Table 6 presents the total frequency of bacterial LRIs by demographic characteristic. Individuals older than 64 years of age consistently experienced the most LRIs each year. Family members comprised the majority of LRIs in the DOD beneficiary population, but retired beneficiaries contributed approximately a quarter of the infections. The TRICARE West region identified the majority of LRIs (35%). Many of the demographic categories displayed significant changes in trends. Of the significant trends, active duty beneficiaries (47%), 18-24 year olds (44%), and the TRICARE South region (28%) had the largest decreases in incidence rates from FY 2009 to FY 2013. Active duty beneficiaries overall had a 47% decrease, however, from FY 2012 to FY 2013, a 34% decrease occurred. The 18-24 year olds overall had a 44% decrease and a 25% decrease from FY 2012 to FY 2013. The South overall had a 28% decrease and FY 2009 to FY 2010 accounted for the highest decrease at 15%.

**Table 6**. Total Lower Bacterial Respiratory Infections by Demographic Category with Rates per 1,000 DOD Beneficiaries, FY 2009-FY 2013[a]

| | FY 2009 | | | | FY 2010 | | | | FY 2011 | | | | FY 2012 | | | | FY 2013 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | n | Rate | CI Lower | CI Upper | Percent change[c] | *P* value[d] |
| 0-4 | 145 | 2.4 | 2.0 | 2.8 | 164 | 2.6 | 2.2 | 3.0 | 115 | 1.8 | 1.5 | 2.1 | 118 | 1.9 | 1.5 | 2.2 | 132 | 2.2 | 1.8 | 2.5 | -11.6 | 0.03 |
| 5-17 | 123 | 0.9 | 0.7 | 1.0 | 133 | 0.9 | 0.8 | 1.1 | 133 | 0.9 | 0.8 | 1.1 | 122 | 0.9 | 0.7 | 1.0 | 136 | 1.0 | 0.8 | 1.1 | 12.5 | 0.54 |
| 18-24 | 383 | 2.9 | 2.6 | 3.2 | 353 | 2.7 | 2.4 | 3.0 | 362 | 2.8 | 2.5 | 3.1 | 279 | 2.2 | 2.0 | 2.5 | 203 | 1.7 | 1.4 | 1.9 | -43.5 | <.01 |
| 25-44 | 444 | 2.2 | 2.0 | 2.4 | 481 | 2.3 | 2.1 | 2.5 | 399 | 1.9 | 1.7 | 2.1 | 387 | 1.8 | 1.7 | 2.0 | 314 | 1.5 | 1.3 | 1.7 | -31.0 | <.01 |
| 45-64 | 705 | 3.2 | 3.0 | 3.4 | 621 | 2.8 | 2.6 | 3.0 | 596 | 2.7 | 2.4 | 2.9 | 517 | 2.3 | 2.1 | 2.5 | 566 | 2.6 | 2.4 | 2.8 | -18.1 | <.01 |
| >64 | 990 | 5.2 | 4.9 | 5.5 | 946 | 4.9 | 4.6 | 5.2 | 882 | 4.5 | 4.2 | 4.8 | 779 | 3.8 | 3.6 | 4.1 | 872 | 4.2 | 3.9 | 4.4 | -19.8 | <.01 |
| Missing | 45 | -- | -- | -- | 19 | -- | -- | -- | 5 | -- | -- | -- | 5 | - | -- | -- | 3 | -- | -- | -- | -- | -- |
| **Gender** | | | | | | | | | | | | | | | | | | | | | | |
| Female | 951 | 2.1 | 1.9 | 2.2 | 904 | 1.9 | 1.8 | 2.0 | 818 | 1.7 | 1.6 | 1.8 | 789 | 1.7 | 1.6 | 1.8 | 786 | 1.7 | 1.6 | 1.8 | -19.0 | <.01 |
| Male | 1,884 | 3.9 | 3.7 | 4.0 | 1,813 | 3.6 | 3.5 | 3.8 | 1,674 | 3.4 | 3.2 | 3.5 | 1,418 | 2.9 | 2.7 | 3.0 | 1,440 | 2.9 | 2.8 | 3.1 | -23.6 | <.01 |
| **Duty Status** | | | | | | | | | | | | | | | | | | | | | | |
| Active Duty | 512 | 3.5 | 3.2 | 3.8 | 502 | 3.4 | 3.1 | 3.6 | 490 | 3.3 | 3.0 | 3.6 | 401 | 2.7 | 2.4 | 3.0 | 264 | 1.8 | 1.6 | 2.0 | -47.3 | <.01 |
| Retired | 744 | 3.6 | 3.3 | 3.9 | 717 | 3.4 | 3.2 | 3.7 | 682 | 3.3 | 3.0 | 3.5 | 564 | 2.7 | 2.4 | 2.9 | 618 | 2.9 | 2.7 | 3.1 | -19.2 | <.01 |
| Family Member | 1,004 | 2.0 | 1.9 | 2.1 | 986 | 1.9 | 1.8 | 2.1 | 882 | 1.7 | 1.6 | 1.8 | 850 | 1.7 | 1.5 | 1.8 | 869 | 1.7 | 1.6 | 1.8 | -14.6 | <.01 |
| Other | 575 | 6.3 | 5.8 | 6.8 | 512 | 5.0 | 4.6 | 5.5 | 438 | 4.4 | 4.0 | 4.8 | 392 | 4.1 | 3.7 | 4.5 | 475 | 5.1 | 4.7 | 5.6 | -18.0 | <.01 |
| **TRICARE Region** | | | | | | | | | | | | | | | | | | | | | | |
| Alaska | 61 | 6.9 | 5.2 | 8.7 | 61 | 6.8 | 5.1 | 8.5 | 48 | 5.4 | 3.9 | 6.9 | 31 | 3.4 | 2.2 | 4.7 | 51 | 5.7 | 4.1 | 7.2 | -18.1 | 0.02 |
| North | 662 | 2.1 | 2.0 | 2.3 | 618 | 2.0 | 1.8 | 2.1 | 641 | 2.1 | 1.9 | 2.2 | 527 | 1.7 | 1.6 | 1.9 | 588 | 2.0 | 1.8 | 2.1 | -7.7 | 0.02 |
| OCONUS[b] | 188 | 4.4 | 3.7 | 5.0 | 197 | 4.7 | 4.0 | 5.3 | 192 | 4.7 | 4.0 | 5.3 | 160 | 4.0 | 3.4 | 4.7 | 125 | 3.3 | 2.7 | 3.9 | -23.9 | 0.01 |
| South | 930 | 3.1 | 2.9 | 3.3 | 832 | 2.7 | 2.6 | 2.9 | 703 | 2.3 | 2.1 | 2.5 | 660 | 2.1 | 2.0 | 2.3 | 697 | 2.2 | 2.1 | 2.4 | -28.0 | <.01 |
| West | 993 | 3.6 | 3.4 | 3.8 | 999 | 3.5 | 3.3 | 3.8 | 864 | 3.0 | 2.8 | 3.2 | 751 | 2.6 | 2.4 | 2.8 | 754 | 2.6 | 2.5 | 2.8 | -26.6 | <.01 |
| Unspecified | 1 | 0.1 | -0.1 | 0.2 | 10 | 0.5 | 0.2 | 0.9 | 44 | 2.2 | 1.6 | 2.9 | 78 | 3.9 | 3.1 | 4.8 | 11 | 0.6 | 0.2 | 0.9 | -- | -- |
| **Total** | 2,835 | -- | -- | -- | 2,717 | -- | -- | -- | 2,492 | -- | -- | -- | 2,207 | -- | -- | -- | 2,226 | -- | -- | -- | -- | -- |

[a] First record per individual per year
[b] OCONUS=Outside the continental United States
[c] Rate percent change was calculated between FY 2009 and FY 2013
[d] P-value determined by conducting a Cochran-Armitage trend test, using all years in the surveillance period
95% Confidence Intervals
Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

Sputum was consistently the most frequent specimen source (74%). LRIs maintained a steady difference between inpatient (55%) and outpatient (45%) settings each year. From FY 2009 to FY 2013, sputum specimens decreased 34%, inpatient cases decreased 32% and outpatient cases decreased 37%. Table 7 presents select clinical characteristics for LRIs.

**Table 7**. Total Lower Bacterial Respiratory Infections by Select Clinical Characteristic among DOD Beneficiaries by Year, FY 2009-FY 2013

| | Total | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 |
|---|---|---|---|---|---|---|
| **Specimen** | | | | | | |
| Bronchial | 2,033 | 479 | 456 | 372 | 360 | 366 |
| Pleural | 220 | 54 | 56 | 39 | 29 | 42 |
| Sputum | 11,003 | 2,453 | 2,520 | 2,355 | 2,064 | 1,611 |
| Trachea | 1,634 | 393 | 449 | 294 | 301 | 197 |
| Lower, NOS[a] | 35 | 5 | 8 | 6 | 6 | 10 |
| **Patient Type** | | | | | | |
| Inpatient | 8,305 | 1,902 | 1,927 | 1,691 | 1,500 | 1,285 |
| Outpatient | 6,621 | 1,482 | 1,562 | 1,375 | 1,261 | 941 |
| Total | 14,926 | 3,384 | 3,489 | 3,066 | 2,761 | 2,226 |

[a] NOS=Nonspecific

Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

There were 2,977 polymicrobial LRIs identified among 2,430 DOD beneficiaries over the five-year study period (Table 8). LRI polymicrobial infections peaked at approximately 670 in FY 2009. Polymicrobial LRIs most commonly occurred in family members (47%) and individuals older than 64 years (29%). The West region consistently had the majority of identified polymicrobial LRIs.

**Table 8.** Total Lower Polymicrobial Respiratory Infections by Demographic Category among DOD Beneficiaries, FY 2009-FY 2013[a]

| | Total | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 |
|---|---|---|---|---|---|---|
| **Age** | | | | | | |
| 0-4 | 263 | 56 | 72 | 38 | 45 | 52 |
| 5-17 | 240 | 45 | 53 | 51 | 43 | 48 |
| 18-24 | 294 | 59 | 69 | 64 | 53 | 49 |
| 25-40 | 361 | 82 | 73 | 64 | 77 | 65 |
| 41-64 | 536 | 123 | 108 | 123 | 94 | 88 |
| >64 | 716 | 148 | 164 | 125 | 140 | 139 |
| Missing | 20 | 13 | 3 | 2 | 1 | 1 |
| **Gender** | | | | | | |
| Female | 864 | 181 | 198 | 170 | 159 | 156 |
| Male | 1,566 | 345 | 344 | 297 | 294 | 286 |
| **Duty Status** | | | | | | |
| Active Duty | 265 | 61 | 52 | 67 | 58 | 27 |
| Recruit | 40 | 11 | 12 | 8 | 2 | 7 |
| Retired | 531 | 108 | 120 | 95 | 110 | 98 |
| Family Member | 1,135 | 238 | 256 | 213 | 206 | 222 |
| Other | 459 | 108 | 102 | 84 | 77 | 88 |
| **TRICARE Region** | | | | | | |
| Alaska | 30 | 6 | 7 | 7 | 2 | 8 |
| North | 595 | 123 | 117 | 116 | 119 | 120 |
| OCONUS[b] | 172 | 33 | 30 | 34 | 43 | 32 |
| South | 678 | 176 | 151 | 126 | 105 | 120 |
| West | 934 | 188 | 237 | 178 | 171 | 160 |
| Unspecified | 21 | 0 | 0 | 6 | 13 | 2 |
| **Total** | 2,430 | 526 | 542 | 467 | 453 | 442 |

[a] First record per individual per year
[b] OCONUS=Outside the continental United States
Data Source: Navy and Marine Corps Public Health Center CHCS HL7 formatted chemistry and microbiology data

Sputum samples yielded the majority of polymicrobial LRIs (69%). Polymicrobial LRIs were evenly distributed among inpatient (49%) and outpatient (51%) cases. *Staphylococcus* and *Pseudomonas spp.* were the most frequently identified organisms in polymicrobial LRIs.

## Discussion

This report presents trends of bacterial URIs and LRIs within the MHS for all DOD beneficiaries from October 2008 to September 2013. The overall frequency of URIs and LRIs declined by 36% and 23%, respectively, from FY 2009 to FY2013. Analysis of available characteristics demonstrates that the decline in URIs was predominantly due to a decrease in the rate of identification of *Streptococcus spp*. Family members and active duty beneficiaries comprised the majority of the decline with significant reductions in rates over the course of the five years. Although there was a decline in the frequency of LRIs, there were few significant trends among organism identification across the years. A significant decreasing trend occurred for *Streptococcus spp*., which accounted for approximately one-fifth of all LRIs identified. Active duty beneficiaries had the largest decline with significant reductions in rates over the course of the five years.

The decreasing trend reported here for URIs and LRIs could be due to a change in clinical practice (testing practice) or a change in disease burden. Exploratory analysis of the burden of disease, by the EDC, showed changes in the volume of encounters, an estimate for MHS healthcare utilization, from FY 2009 through FY 2013; these changes were not consistent with the URI and LRI decreasing trends observed in this study. Encounters increased by approximately 12% from FY 2009 to FY 2013, compared to the 36% and 23% decrease seen in laboratory identified URIs and LRIs, respectively. However, encounter increases may be due to other factors such as performance-based budgeting, therefore we need additional analysis to draw conclusions on the increase in MHS utilization for acute care. Exploratory analysis of testing practice suggests respiratory laboratory practice also may not explain the decrease in URI or LRI; while the volume of chemistry and microbiology workload in the MHS decreased 20% over the past 5 years, the proportion of respiratory tests remained the same at 2%. This suggests respiratory testing practices are not likely influencing the 36% and 23% decreases in laboratory identified URIs and LRIs, respectively. Furthermore, other studies suggest that respiratory illness may be declining. Barnett and Lindler report a decrease in primary diagnoses of throat soreness or pain among adults in the US population, from 7.5% in 1997 to 4.3% in 2010.[15] A recent Armed Forces Health Surveillance Center (AFHSC) study showed a 15% decline in the number of ambulatory respiratory visits from 2008 to 2012 among active duty members.[3] Based on this study a decline was observed within our data, but further studies and comparisons are needed to confirm if the decrease seen in this analysis is in fact a decrease in disease burden.

URIs peaked in winter months and decreased in spring and summer months. This seasonality may reflect the fact that populations spend more time indoors during the winter and are more often exposed to enclosed spaces (e.g., schools, barracks) and co-circulating infectious agents. Synergistic relationships can also occur between bacteria and viruses within a human host,

leading to prolonged clinical symptoms and possibly the need to seek care resulting in a confirmatory laboratory result.[4-6] Our data indicates strong seasonal trends for URIs among the DOD population.

Although age groups 0-44 years of age all experienced significant decreasing trends, the most impacted by URIs throughout the study period were those 5-17 years of age and active duty beneficiaries. Literature suggests URIs impact infants, children, adolescents, and adults more often than the elderly. Group A beta-hemolytic streptococci primarily affects children 3-18 years of age, Group C streptococci particularly affects teenagers and young adults, and bacterial rhinosinusitis is a common complication after viral infection in children and adults.[16-18] Also due to occupational situations active duty service members may be at higher risk due to crowded living environments and job stress.

Individuals 0-4 years of age experienced the majority of polymicrobial infections, most commonly as some form of otitis. Not only does the literature support that children younger than 3 years have the highest prevalence of otitis media,[19] but studies recognize that otitis media has a biofilm component.[11] In FY 2013, the age distribution of the polymicrobial URI subset in this analysis was not as skewed toward the youngest age group. Infections still occurred in predominantly younger age groups, but the gap in frequency between the 0-4 age group and 5-17 age group decreased. Also in FY 2013, throat specimens accounted for 58% (n=71) of the 0-4 age group specimens, whereas ear specimens accounted for just 29% (n=35). This differs from the expected range of 47-57% (n=53-88) attributed to otitis infections in previous years. Early in 2013, the American Academy of Pediatrics issued stricter diagnostic criteria for common childhood respiratory illnesses, including ear infections.[20,21] It is unlikely the stricter criteria impacted the findings in this report due to the timing of the guidance, but the relationship should be re-evaluated at a later date to see if declines are maintained.

LRIs lacked the seasonality seen among URIs. The literature does not provide adequate insight into seasonal trends of LRIs; however, specific organism activity associated with LRIs may address the observations seen in this study. Some literature supports the existence of opposing seasons of peak activity with different organisms, particularly *P. aeruginosa* and *S. aureus,* which were the two most frequently identified organisms for LRIs. Perencerich *et al.* found a 28% higher rate of hospital-associated *P. aeruginosa* infection in summer months compared to winter months and no significant summer peaks for *S. aureus.* The study included all clinical specimens, but lower respiratory specimens accounted for 28% of *P. aeruginosa* and 25% of *S. aureus* specimens.[22] Psoter *et al.* also demonstrated summer peaks for *P. aeruginosa* in cystic fibrosis patients. The study also investigated *S. aureus* and noted the lack of seasonal variation for this population as well.[23] The lack of seasonality suggests clinicians need to be aware of the risk of LRIs among populations at higher risk.

Among DOD beneficiaries, each duty status had significant trends, with the active duty beneficiaries decreasing by nearly 50% from FY 2009 to FY 2013. Over 90% of the active duty LRIs fell into the age categories 18-24 and 25-44, these age groups also had 44% and 31% decreases, respectively. The majority of the decline for each of these beneficiary categories

occurred from FY 2012 to FY 2013. It is unknown if the initiation of a specific infection control practice or a true decline in disease burden affected the trend and more investigation is needed to determine the mechanism and observe if the trend will continue.

This analysis also found that individuals older than 64 years of age were the most impacted age group. This age group had the highest rates of LRIs and the highest frequencies of polymicrobial LRIs. This population (65 and older) is generally associated with comorbidities and a diversity of underlying conditions. Typically, LRIs more frequently impact infants, young children, the elderly, and populations with poor health.[24,25] The observations of this study agree with the literature on LRIs for older age demographics.

This report assessed recent trends in URIs and LRIs in the US DOD beneficiary population. URIs and LRIs will continue to be tracked and monitored. Periodic monitoring of both URIs and LRIs is important, especially during periods of high respiratory illness activity, because of the synergistic relationship between respiratory bacteria and co-circulating viruses that can lead to increased morbidity and mortality. In addition, the occupational realities of DOD personnel, such as frequent deployments, relocations, and travel, increase the risk of respiratory illnesses. Limiting coinfections, promoting vaccination of available immunizations, and continuing to develop vaccines could all potentially contribute to risk reduction of bacterial respiratory illness. Periodic monitoring of bacterial respiratory infections may contribute to risk reduction by identifying at risk populations to define population specific interventions, allowing for the mitigation of increased morbidity and mortality.

## Limitations

This study included several important limitations. First, HL7 microbiology and chemistry data considered in this report originated at fixed MTFs and do not include records from shipboard, battalion aid stations, or in theater facilities. This limitation predominantly excludes from the study those active duty members seen and treated in a forward clinic or aid station. The active duty component comprises approximately 15% of the beneficiary population. Because an even smaller proportion of active duty personnel is served solely by non-fixed MTFs and this report included all DOD beneficiaries seeking care within the MHS, the inability to include this subpopulation of active duty members likely does not significantly impact trends reported here.

Chemistry and microbiology data are useful for identifying laboratory-confirmed cases of illness. However, cases in which a physician chooses to treat presumptively without laboratory confirmation are not captured. Testing practices vary between providers and facilities. It is unclear how often presumptive treatment occurs in cases of bacterial respiratory infection. Presumptive treatment may lead to the underestimation of the true burden of respiratory bacterial infections.

This analysis included only the eight most prevalent and clinically significant genera. *Streptococcus, Staphylococcus, Haemophilus*, *Klebsiella*, and *Moraxella spp.* are clinically significant because they frequently cause bacterial URIs and LRIs. *Pseudomonas*, *Enterobacter,*

and *Escherichia spp.* were prevalent among the DOD beneficiary population. These organisms may be clinically significant among specific subpopulations within the DOD, and may be more prevalent among certain individuals with specific comorbidities and conditions and not necessarily prevalent among a healthier population including the active duty component. From all the organisms identified in microbiology data during the retrospective analysis within the upper respiratory system, the subset presented in this report captured nearly all (99%) of all organisms. From organisms identified in the lower respiratory system, 83% were included in this report. Furthermore, classifying microbiology tests involves extensive searching of free-text test result fields. The organisms in this report are typically part of normal respiratory flora. If a record identified an organism but did not identify the organism as normal flora, the record remained in the analysis. This report assumes clinicians performed cultures due to the clinical presentation, although it is possible that some test results were misclassified, despite validation steps taken to reduce error.

Rapid diagnostic *Streptococcus spp.* testing records vary by facility. Identification of rapid tests from throat specimens occurred, but some results did not specify Group A organisms and were therefore classified in the general *Streptococcus* species category. Positive tests remained in the analysis, although misclassification of the organism at the species level may have occurred. A subset of facilities performed rapid diagnostic *Streptococcus* tests, but consistently had nonspecific specimens identified within the records. Nonspecific specimens are records that indicate only swabs with no reference to a particular respiratory site. Analysis excluded these nonspecific records, which may result in underreporting for specific regions. Further analysis of these records revealed that approximately 6,000 positive records, or only 2% of the total data had they been included, were not captured from FY 2009 to FY 2012.

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## Acronym/Abbreviation List

| Acronym/Abbreviation | Definition |
|---|---|
| AFHSC | Armed Forces Health Surveillance Center |
| ARD | Acute respiratory disease |
| CHCS | Composite Health Care System |
| DOD | Department of Defense |
| DON | Department of the Navy |
| EDC | EpiData Center |
| FRI | Febril respiratory illness |
| FY | Fiscal year |
| GAS | *Streptococcus* Group A |
| HL7 | Health Level 7 |
| LRI | Lower respiratory infection |
| M2 | Military Health System Mart |
| MHS | Military Health System |
| MTF | Military treatment facility |
| NHRC | Naval Health Research Center |
| NMCPHC | Navy and Marine Corps Public Health Center |
| OCONUS | Outside the continental United States |
| URI | Upper respiratory infection |
| US | United States |